USDA Forest Service

Caring for the land and serving people

Air Quality in the USDA Forest Service: A Two Way Street

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Cloud Peak Wilderness, Wyoming

An area where natural visibility conditions should exist

A Two Way Street:
Forest Service Air Resource Management Objectives

- Protect the National Forests from the adverse effects of man-caused air pollution
- Minimize emissions from management activities and conform with the law

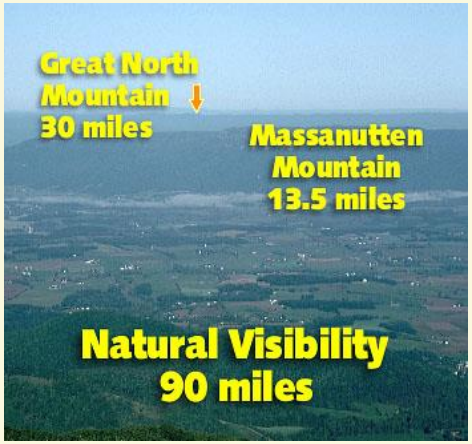
Protecting the National Forests from Man-Caused Air Pollution

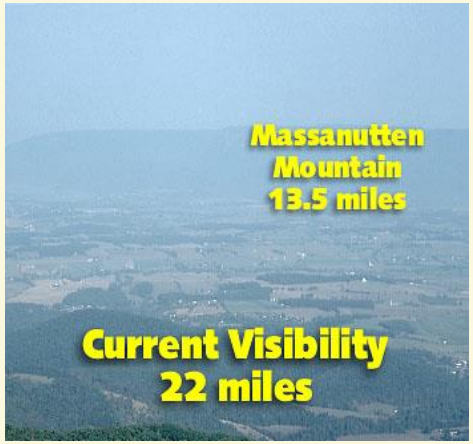
- Visibility
- Deposition to watersheds
- Respiration by flora and fauna
- Deterioration of cultural artifacts

Visibility

- National Goal: Natural visibility in 155 class I areas by 2064
- 86 Class I wildernesses are now impaired by haze
- Regional Haze Rule: States must create the first 10 year approvable plan by the end of this year.
- Track progress: Interagency aerosol monitoring (IMPROVE)

In the last century, visibility declined 80% in the Eastern U.S. and 20% in the West due to air pollution.





Simulating natural and current visibility near the James River Face Wilderness, Virginia using IMPROVE data

Weminuche Wilderness, Colorado

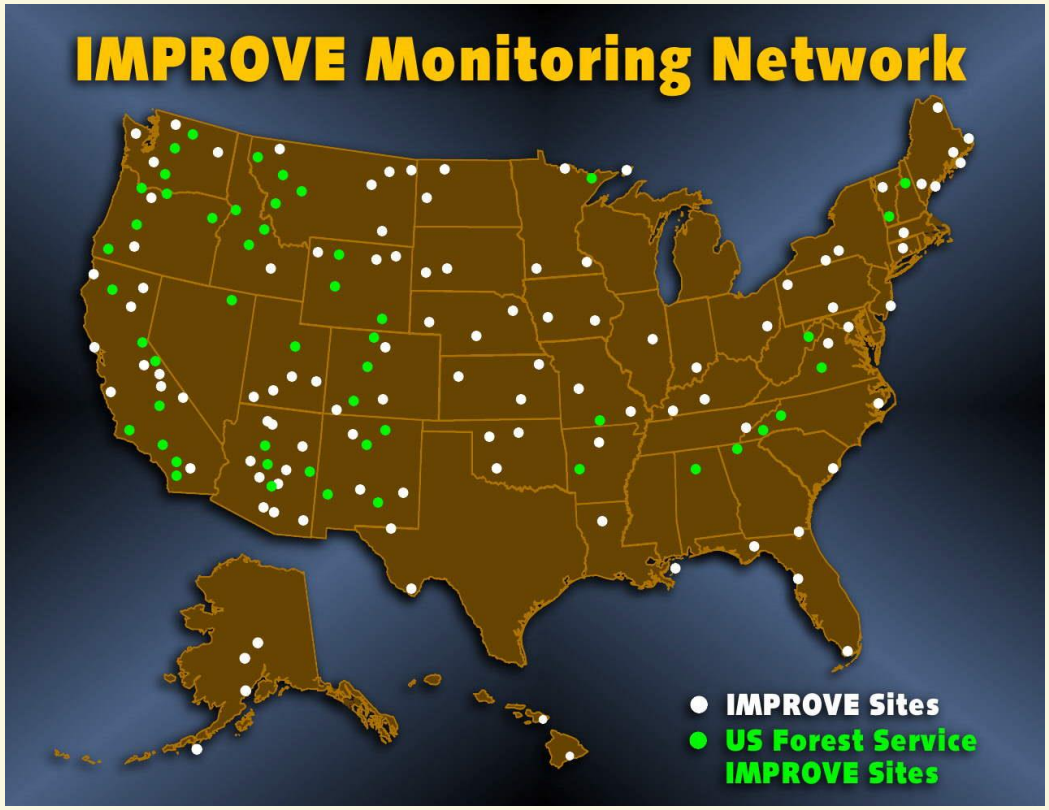
Clear Day 90%ile

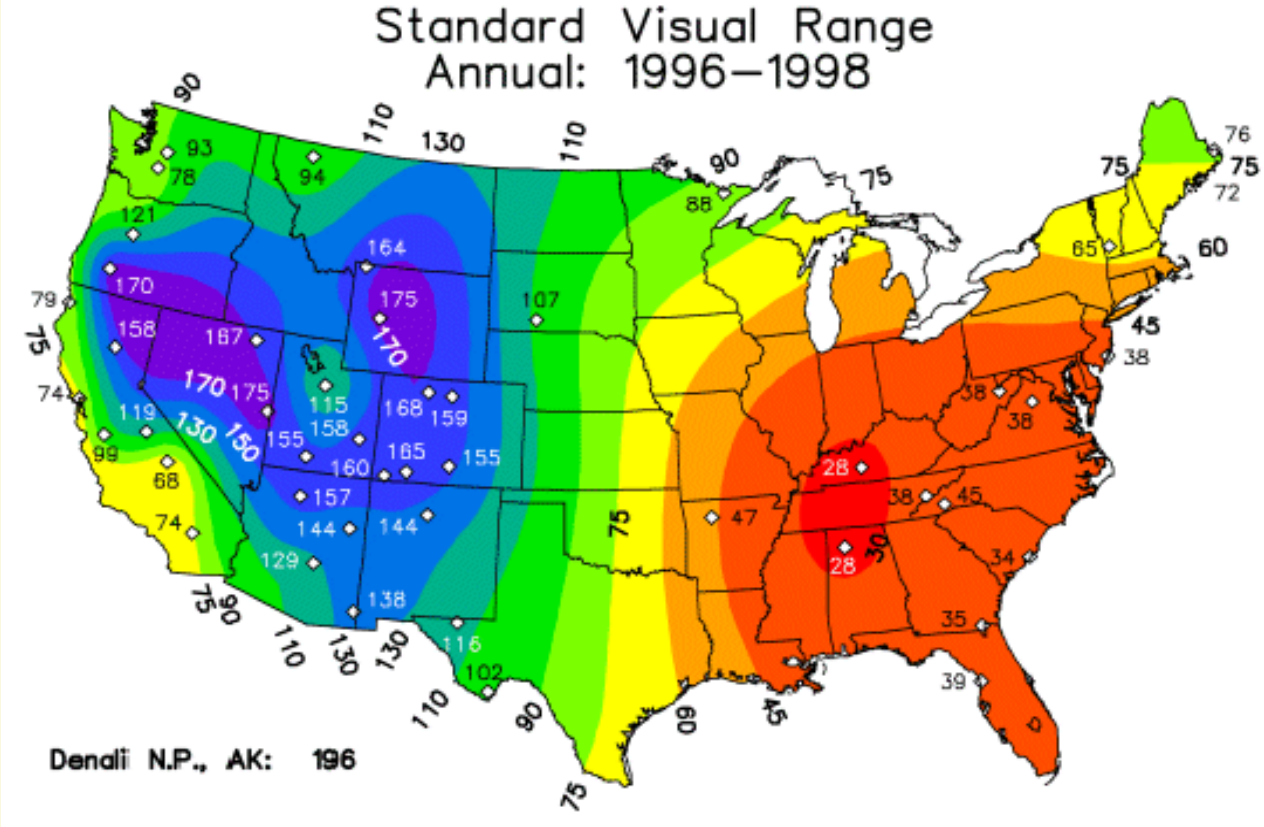
Hazy Day 10%ile

Visibility is worsening near energy development areas in NM, CO, WY and UT

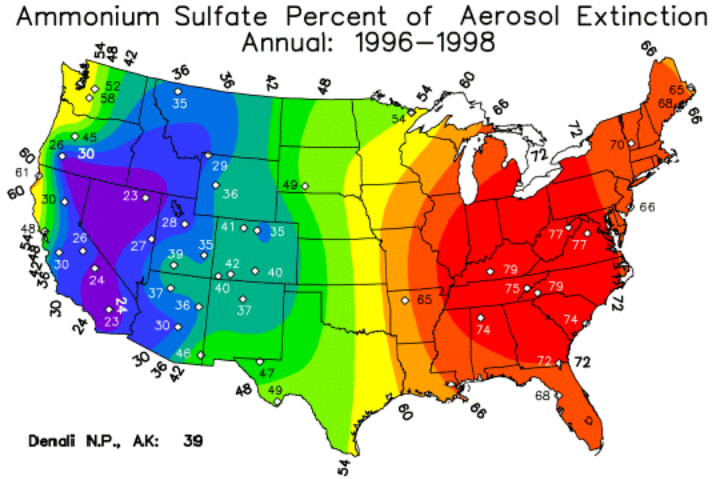
- **IMPROVE** is the national visibility and fine particulate monitoring program with over 163 monitoring sites

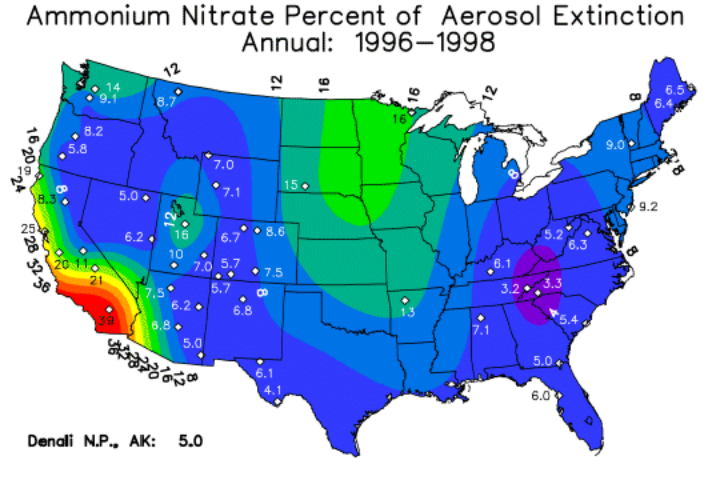
- **1/3** are US Forest Service sites

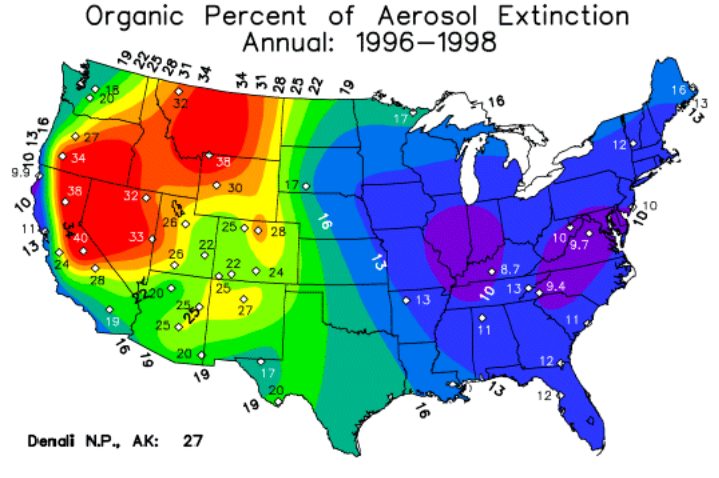




Average annual visibility (km) calculated from aerosol concentrations measured in the IMPROVE monitoring program is worst in the East and best in the West.







Sulfates, nitrates, and organic aerosols are key manmade pollutants adversely affecting visibility and other resources on forests nationwide.

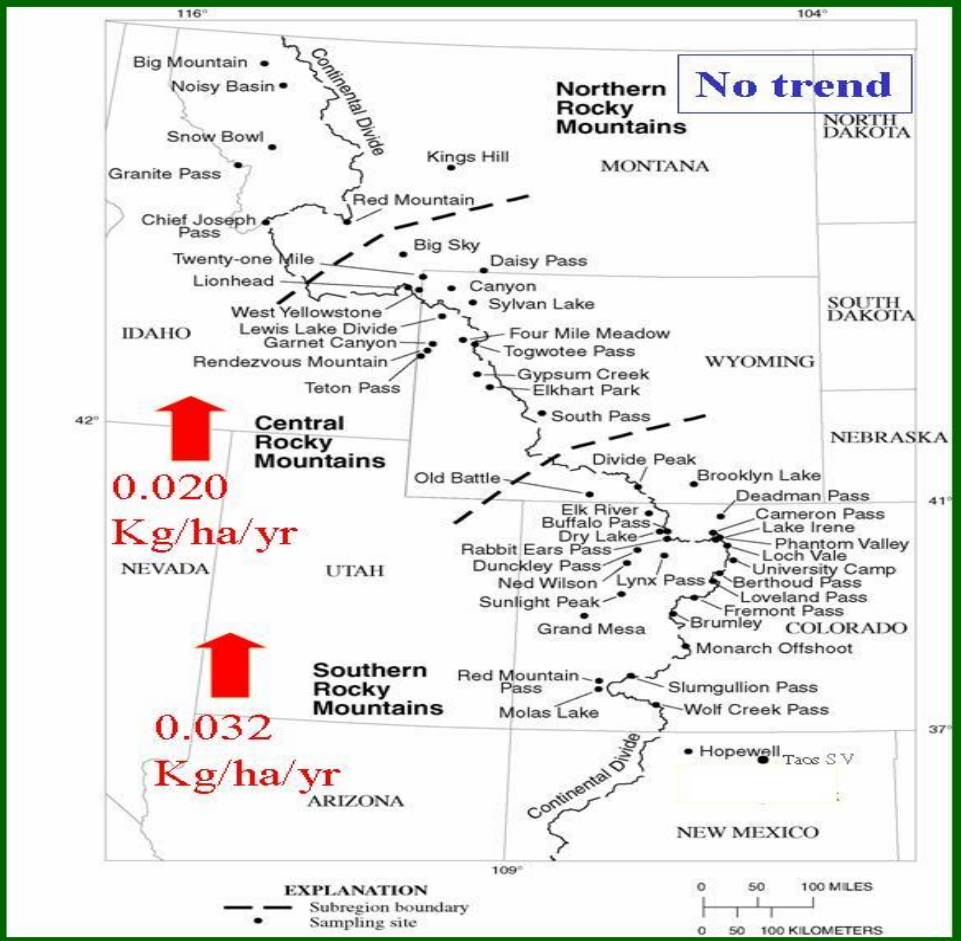
Deposition to Watersheds

- Decades of high sulfur deposition in the eastern US has acidified many headwater streams.
- Excess nitrogen across the US is causing eutrophication and in some places acidification of mountain surface watersheds.
- Mercury, common in rainfall across the US, is a hazard to humans who eat Hg bioaccumulators such as fish.
- Snowpack accumulation of sulfate or nitrate and subsequent pulses during runoff threaten invertebrates & other forest life and make more costly the purification of drinking water

Snowpack
Chemistry
Monitoring

Nitrate

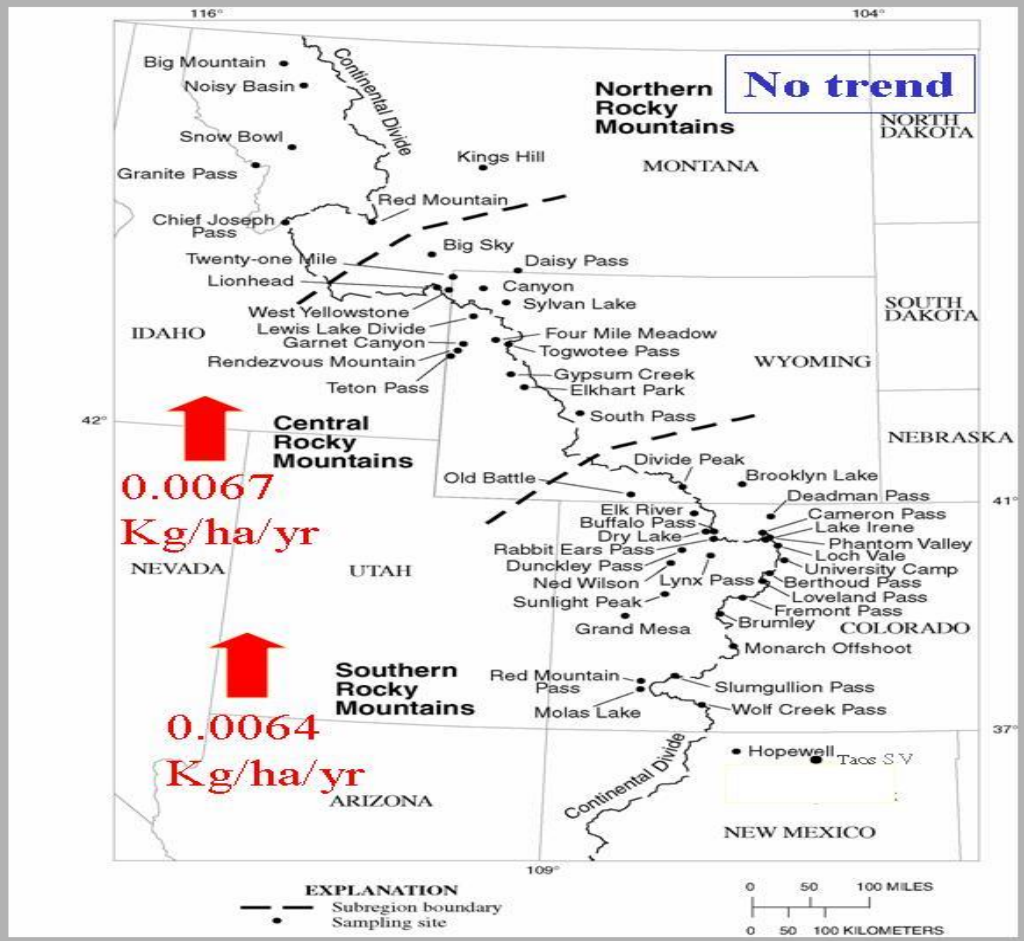
Sub-regions evaluated for long-term trends, 1993-2004, NO3



Snowpack Chemistry Monitoring

Ammonium

Sub-regions evaluated for long-term trends, 1993-2004, NH4



Respiration by Flora

- Ozone is toxic to some individuals of some plant species especially during drought.

- Ozone with high nitrogen deposition can cause early senescence of leaves together with more vigorous growth resulting in increased leaf litter and a higher fire danger,

Passive Ozone Monitoring

Exposure for a week or two.

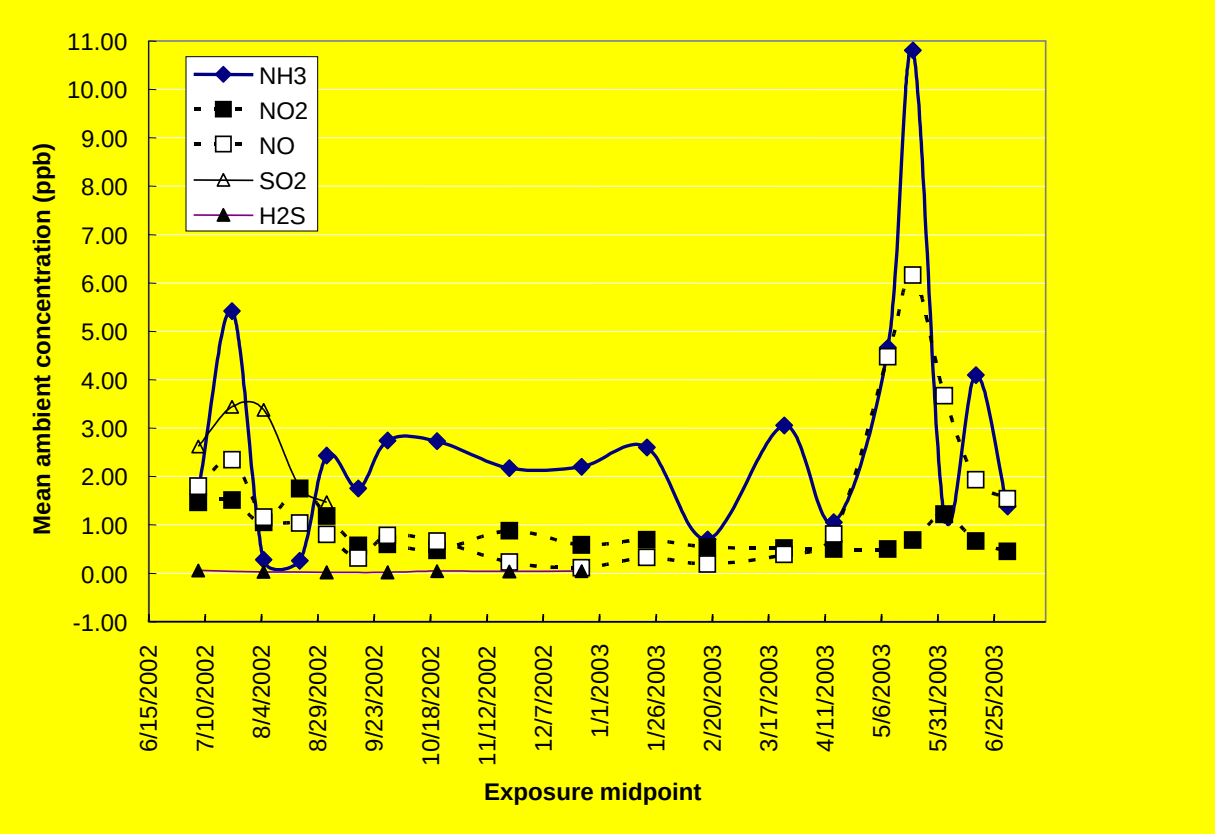
Used together with continuous samplers.

Deterioration of Cultural Artifacts

- Ammonia can fertilize undesirable plants and lichens.
- Undesirable lichens can destroy petroglyphs

Example: Hells Canyon

Xanthoria Elegens



Hells Canyon National Recreation Area
Canyon floor ambient air concentrations (ppb) of O3, SO2, H2S, NOx and NH3.

Minimize Emissions from Management Activities and Conform with the Law

- Smoke from prescribed fire
- Emissions from vehicles
- Fugitive and road dust
- Minerals development

Smoke from Prescribed Fire

- Fuel reduction and habitat improvement projects are necessary to restore healthy ecosystems
- Wildland fires produce fine particles (PM2.5) and ozone precursors
- Improved smoke prediction tools
- Mobile fine particle monitoring w/ realtime web posting

Criteria Pollutants

National Air Quality Standards

- Carbon Monoxide
- Particulate Matter
- Ozone
- Nitrogen Oxide
- Lead
- Sulfur Dioxide

Key criteria pollutants generated by fire

USDA Forest Service

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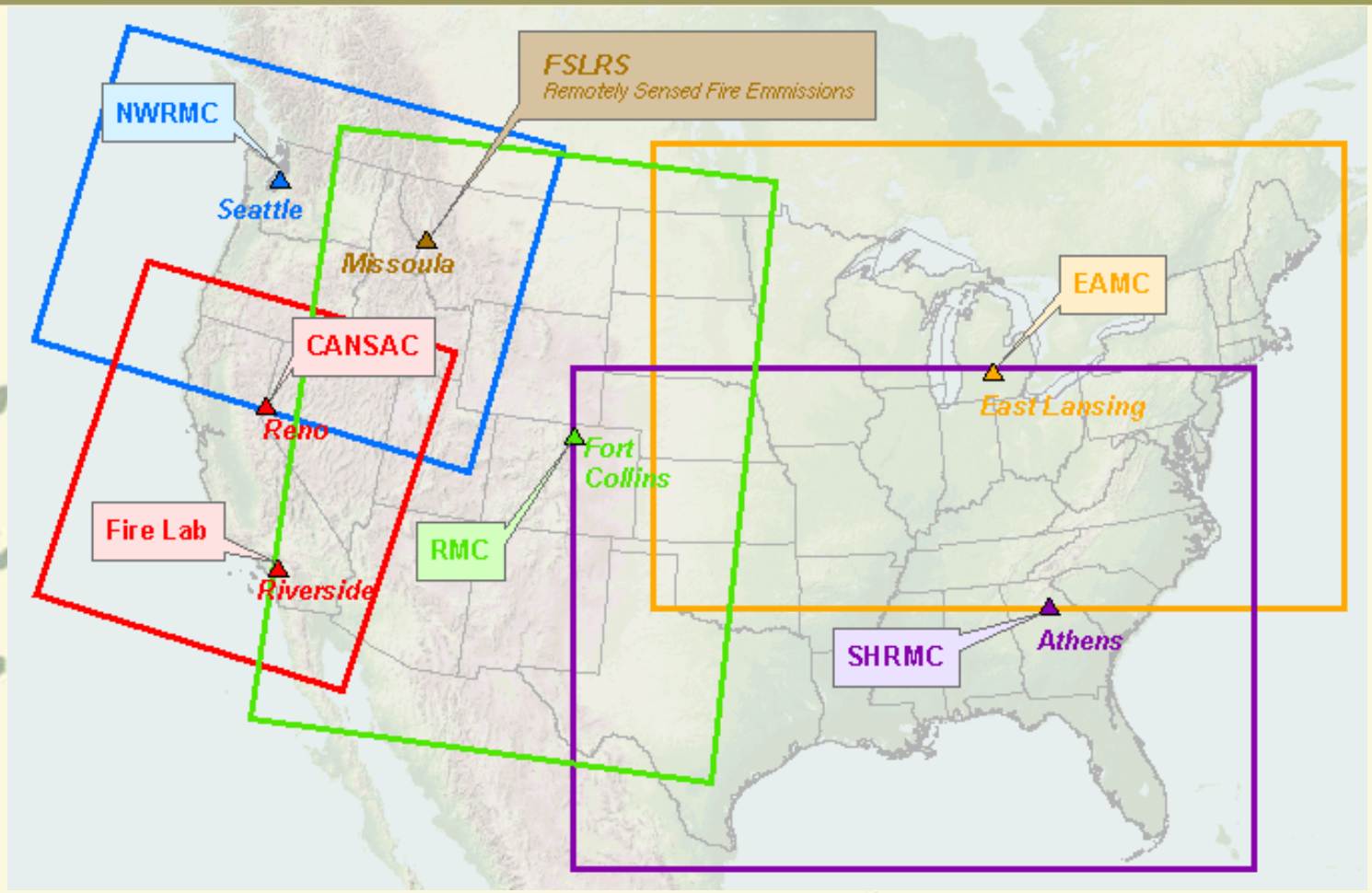


Fire Consortia for Advanced Modeling of Meteorology and Smoke

www.fs.fed.us/FCAMMS)

http://r0trickle.r10.epa.gov/website/bluewest/viewer.htm?Box=-927109.0:1088459.0:1212052.0:-999 - Microsoft Internet Explorer

Western Blue Sky Rains

Information about Potential Wildfire Smoke Impacts

Display Data For:

Sep | 2 | 1 pm

2004 | PDT

-3HR | -HR | Refresh Map | +HR | +3HR

Auto Refresh

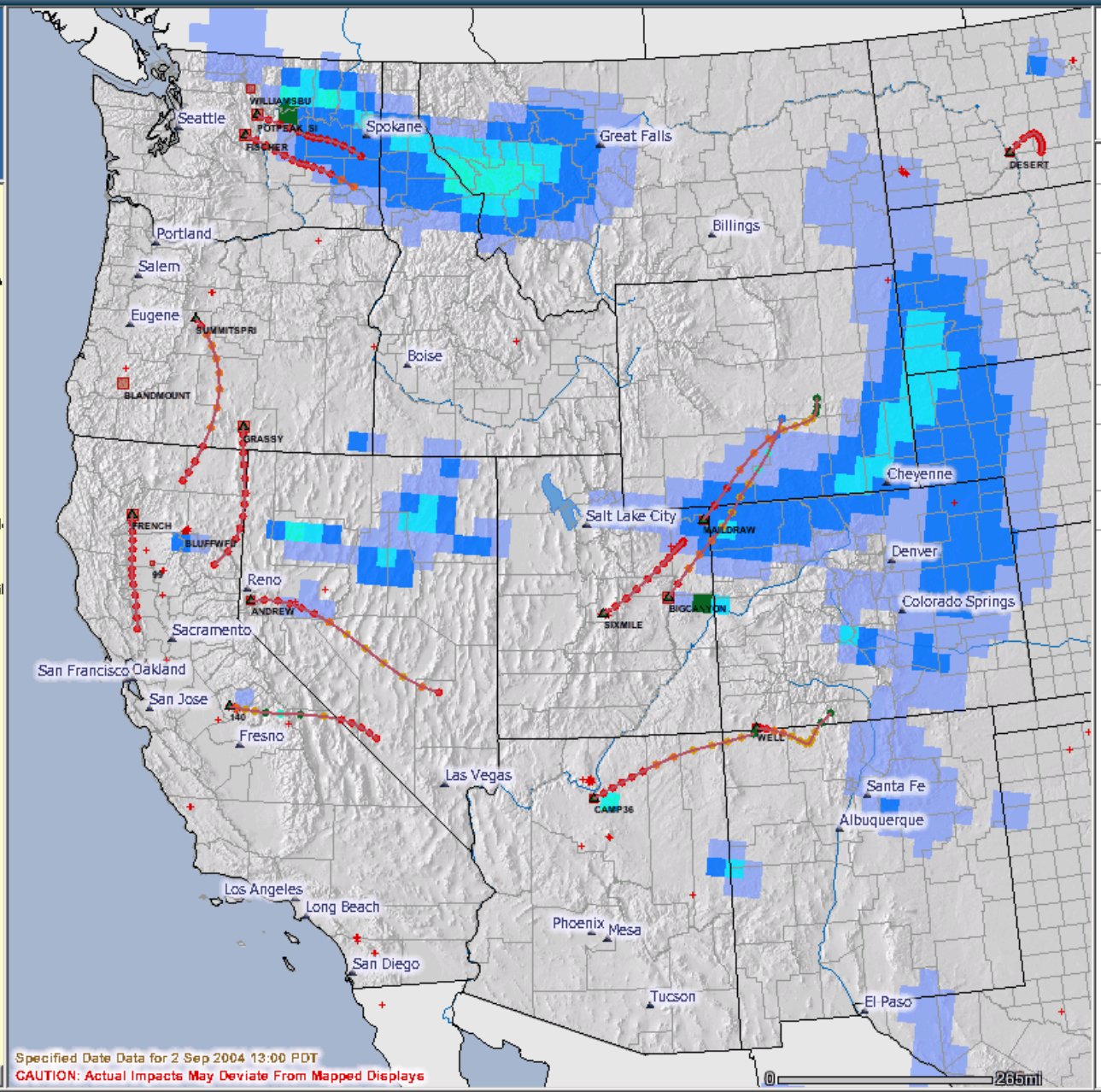
Data Layers

- 36km Burn Information
- 36km Predicted Weather
- 12km NW Burn Information
- 12km NW Predicted Weather (N/A
- Other Pollution Sources
- Observed Air Quality
- Receptors
- Base Map Data

AIRNOW | View Animations

Layer Help

- A closed **group**, click to open.
- An open **group**, click to close.
- A hidden group/layer, click to make visibl
- A visible group/layer, click to hide.
- A visible layer, but not at this scale.
- A partially visible group, click to make visil
- An inactive layer, click to make active.
- The active layer.
- Hyperlink toolbutton available.
- Meta Link to Metadata (click to view)
- A map layer.



Map Legend

Burn Locations
- 0 - 100 Acres
- 100 - 1000 Acres
- >1000 Acres

Burn Traj Hourly Pts
Hours From Start
0 2 4 6 8 10 12

Meters Above Surface
- < 100
- 100 -250
- 250-500
- 500-750
- 750-1000
- 1000-1500
- 1500-2000
- > 2000

Burn Traj Lines

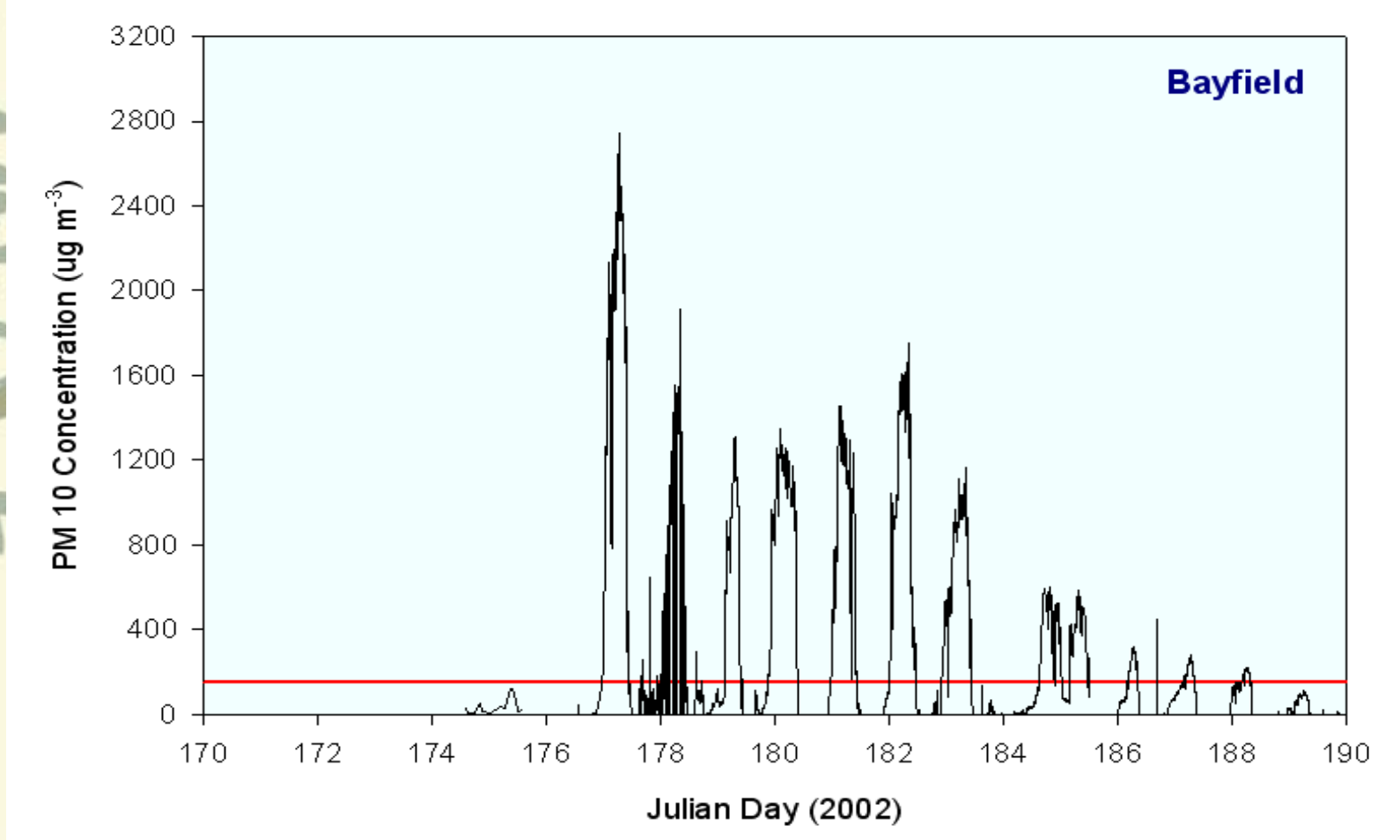
Predicted PM2.5 36km
1 5 10 20 40 60 >65
Low Mod High

NOAA Fire Detects

Tool Help | Zoom/Back | Pan/Move | Select/Show/Clear Data | Print/Download

Real-time Remote Smoke Monitoring System
DataRam 4 & ADSI Satellite Modem

PM 10 Bayfield, CO 15 miles Downwind of the Missionary Ridge Fire June 2002



Emissions from Vehicles

- Average urban vehicle emits 30 to 40 milligrams ppvm
- Average rural vehicle emits 200 to 300 milligrams ppvm

- Biodiesel is increasingly being used in gov vehicles

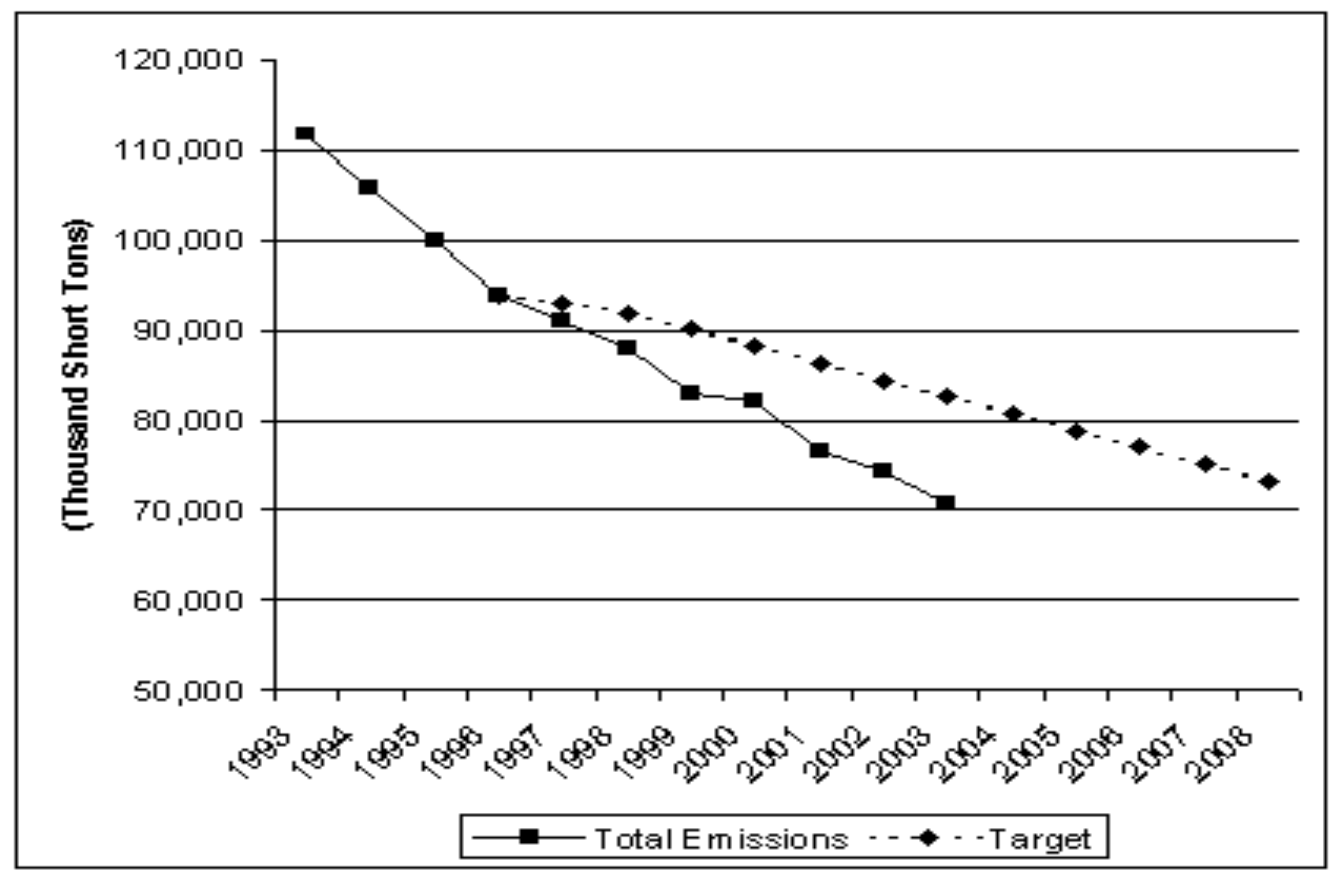
- More emphasis needed on:
  - Hybrid and alternative technology vehicles
  - Reduced vehicle miles
  - Remote sensing to gather field data

- ORVs (4-wheelers & snowmobiles, especially 2-cycle engines)
  - Surface disturbance promotes fugitive dust
  - Accumulated sources in poor dispersion areas can cause unhealthy air

Primary Air Quality Standards for Transportation-related Pollutants

Pollutant	Averaging Times	Concentration
CO	8 hour	9 ppm
	1 hour	35 ppm
Ozone	8 hour	80 ppb
	1 hour	120 ppb
PM2.5	24 hour	15 ugm/m3
	Annual	65 ugm/m3
PM10	24 hour	50 ugm/m3
	Annual	150 ugm/m3

On-Road Mobile Source Emissions (1993-2003*)



Percent Contribution in National Inventory of Sources

Pollutant / Type		NOx	CO	VOC
On-Road		35	56	27
Non-Road		19	22	16
Industrial		5	4	46
Fuel Combustion		39	4	6
Misc		2	15	5

Non-Road Vehicles Emissions

- The entire range of non-road emissions accounted for 49% of engine produced emissions of all types.
- Recreational non-road vehicles produced an aggregate of <4% of all HC emissions in the US based
  - <1.2M ATVs used <350 hrs annually on average
  - EPA emission regulations now include such engines starting with model year 2006.
- ATV consumes less than 59 gallons of fuel per year and obtains between 40 and 50 mpg

Fugitive and Road Dust

383,000 miles of roads on the 192 million acres of national forests in 2000 (most not paved)

approx 1 mile of road surface per sq mile of forest

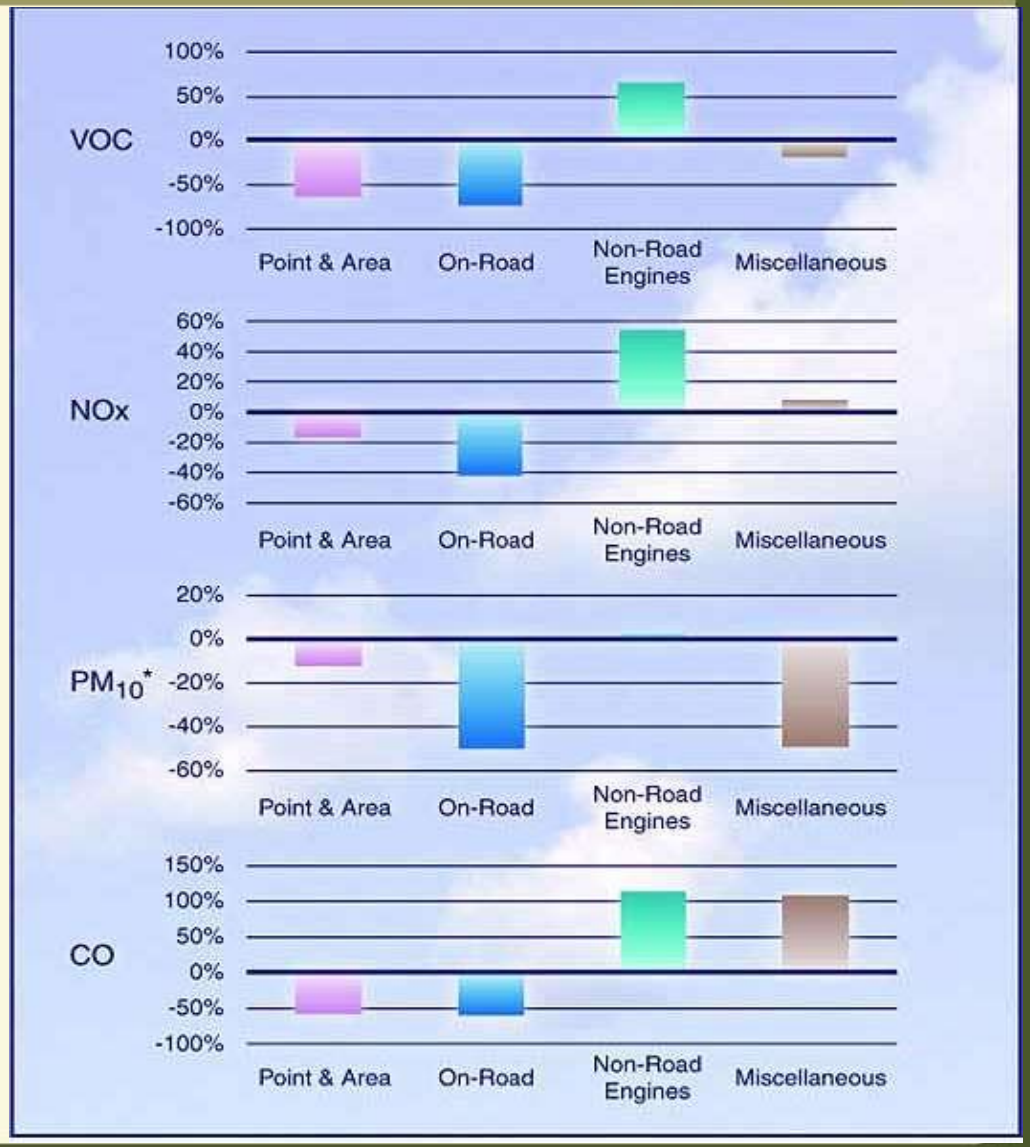
Control methods

- Surfactants
- Speed limits

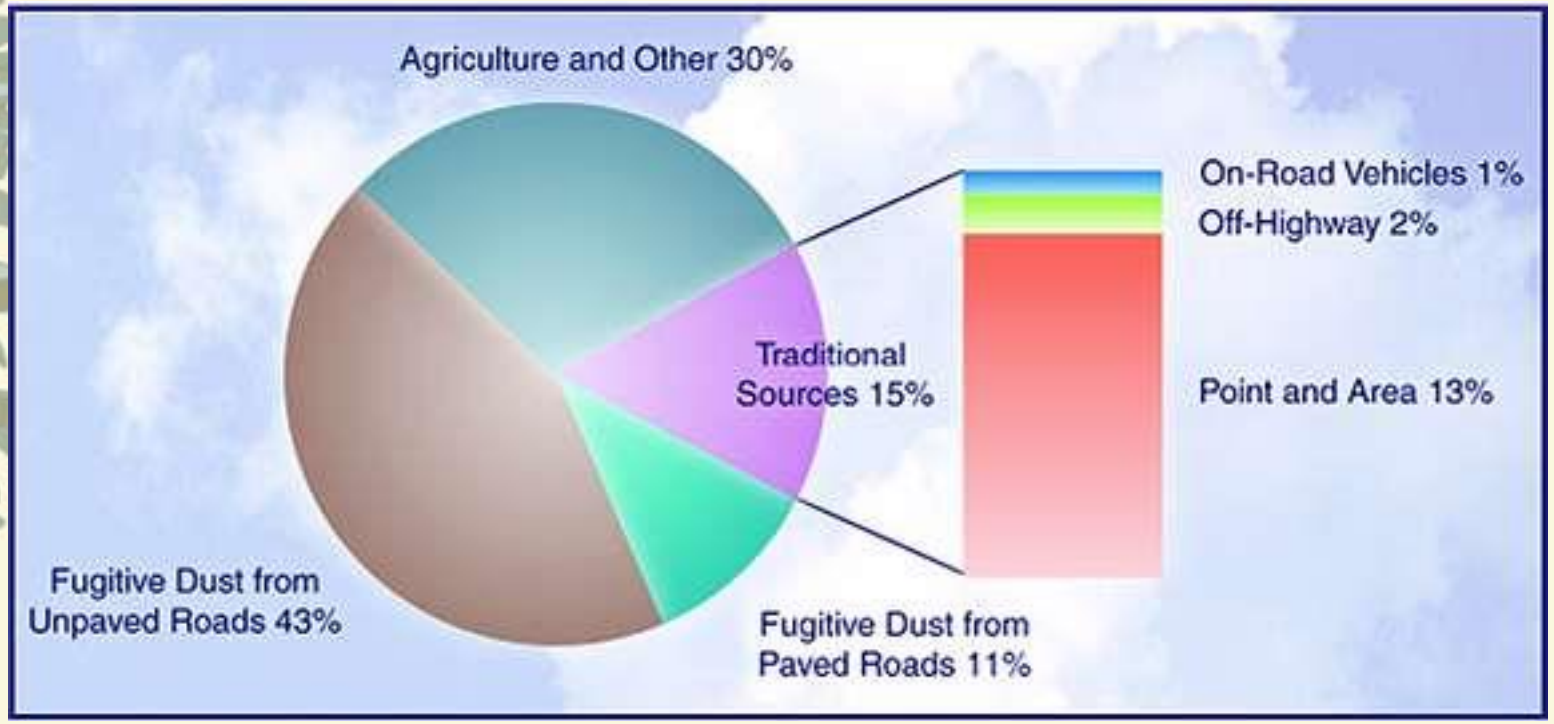
Emissions Trends 1970-2002

Miscellaneous:
Wildfires
Agricultural fires
Health services
Windblown dust
Cooling towers

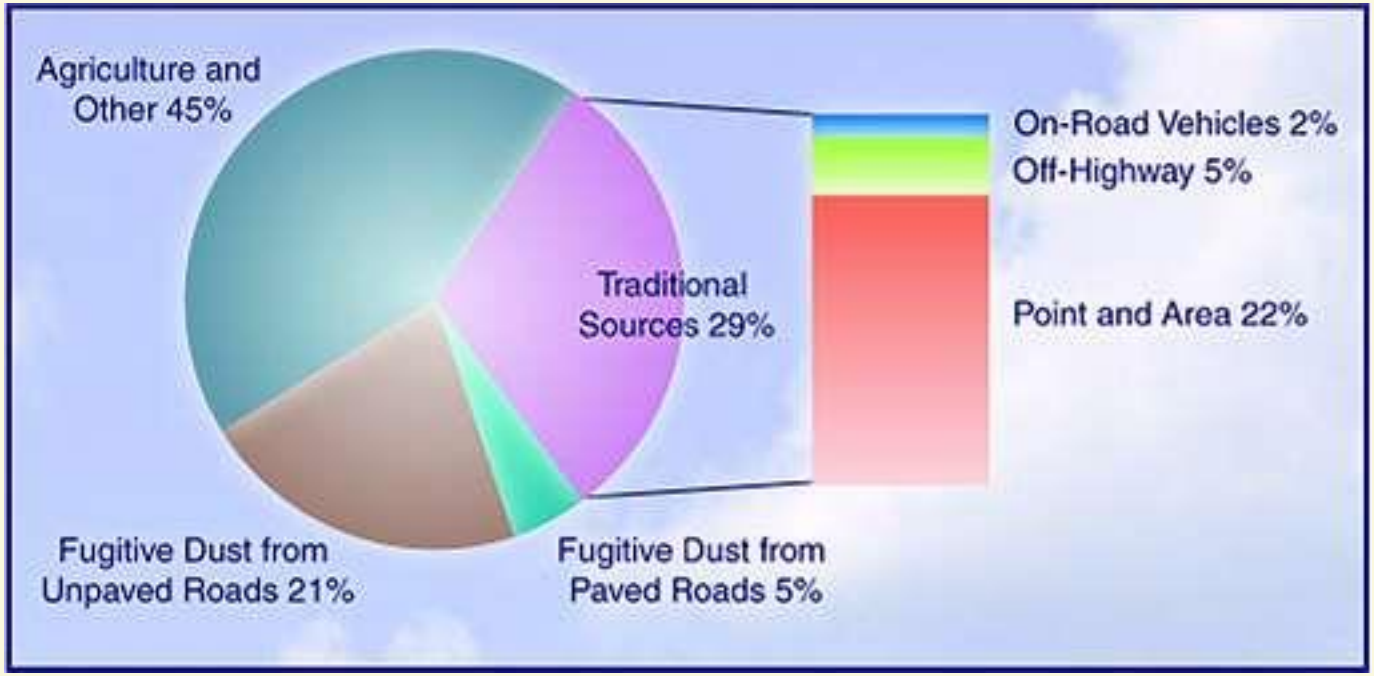
Non Road Engines:
Lawn and garden equipment
Construction equipment
Farm equipment
Aircraft
Railroads
Boats and other marine vessels



PM10 Emissions 2002


Agriculture and Other 30%
On-Road Vehicles 1%
Off-Highway 2%
Traditional Sources 15%
Point and Area 13%
Fugitive Dust from Unpaved Roads 43%
Fugitive Dust from Paved Roads 11%

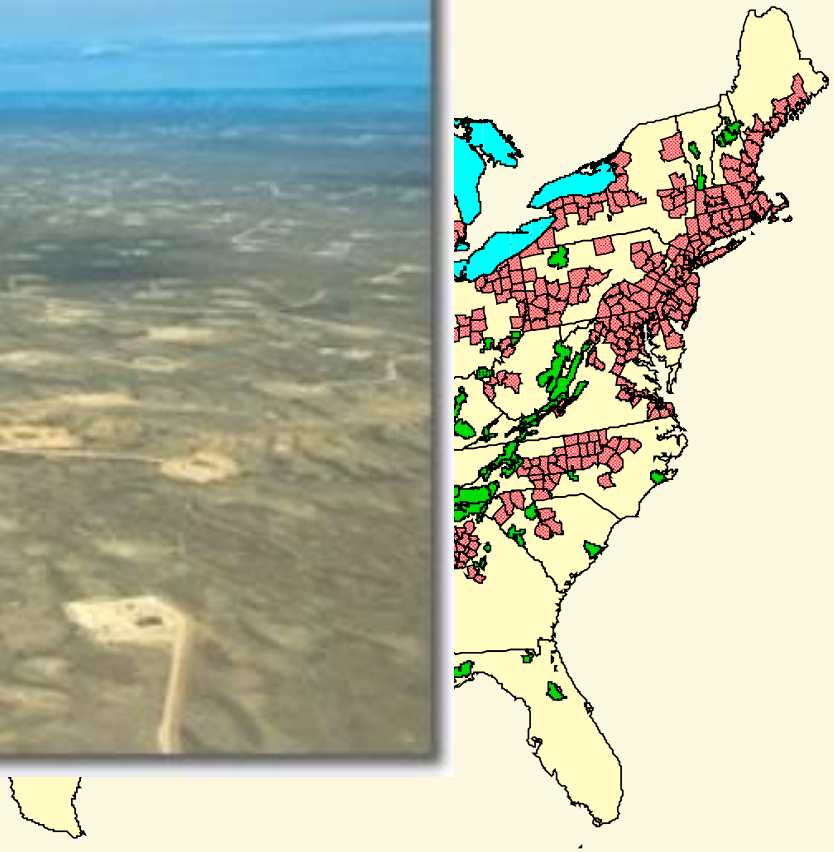
PM2.5 Emissions 2002


Agriculture and Other 45%
Traditional Sources 29%
Fugitive Dust from Unpaved Roads 21%
Fugitive Dust from Paved Roads 5%
On-Road Vehicles 2%
Off-Highway 5%
Point and Area 22%

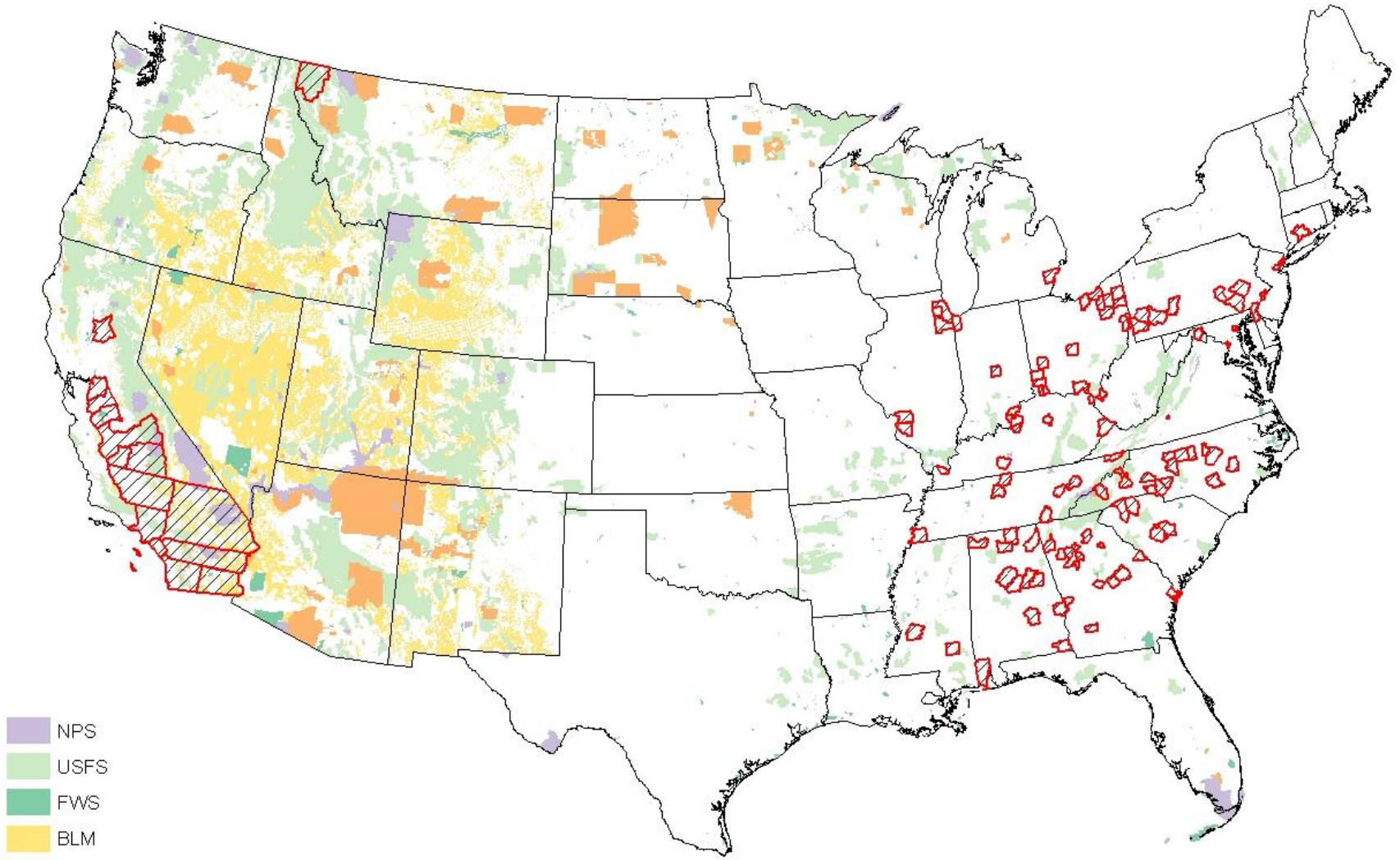
Minerals Development

- Energy independence is a national security issue
- Oil & gas is being leased faster than development can occur
- Stewardship of air and water requires more careful consideration

Non-Attainment Areas

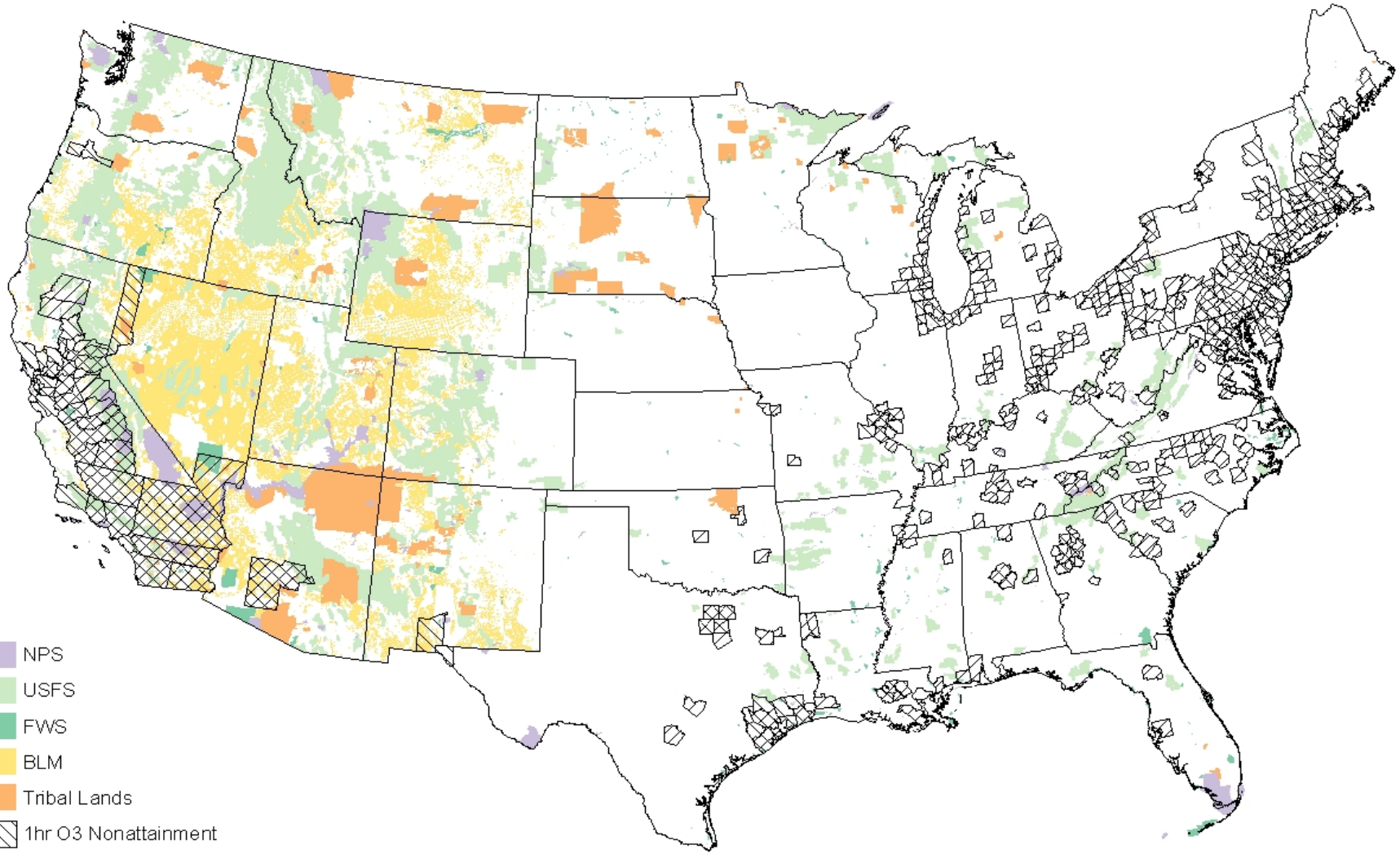


Potential PM2.5 Nonattainment Areas and Federal Lands



Produced by NPS Air Resources Division

Potential 1 and 8hr Ozone Nonattainment Areas and Federal Lands



Produced by NPS Air Resources Division

What are our objectives in the air program ?

- Strive for naturally functioning ecosystems unimpaired by human-caused air pollution.
- Strive for visibility unimpaired by human-caused air pollution

Will we ever get there ?

No… but we can continuously move towards cleaner air by working with others to…

- **Reduce or eliminate emissions from existing human-caused sources**
- **Ensure that new sources are**
  - **cleanest possible**
  - **properly sited & operated**

And…

- **Be responsible emitters and land managers**
  - **Minimize smoke and it's impacts**
  - **Reduce road dust**
  - **Reduce vehicle emissions**
  - **Encourage low NOx biofuel use**
  - **Encourage carbon sequestration**
  - **Encourage conservation**

V I S I O N

The Air Program envisions a healthy environment for current and future generations where natural processes occur.

We believe that:

- **The health of humans and ecosystems are inseparable**
- **Clean air is essential**
- **Science is the foundation for taking action.**